View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Elsevier - Publisher Connector

Available online at www.sciencedirect.com

SciVerse ScienceDirect

Procedia - Social and Behavioral Sciences 48 (2012) 3492 – 3507

Procedia
Social and Behavioral Sciences

Transport Research Arena – Europe 2012

Assessment of rail research capabilities of new and potential EU member states

Cristian Ulianov[a,*], Siân Evans[a], Mark Robinson[a]

[a] *NewRail Newcastle Centre for Railway Research, Newcastle University, Stephenson Bldg., Newcastle upon Tyne, NE1 7RU, United Kingdom*

Abstract

The EU funded project TransNew has analysed the transport research capabilities of new member, associated states, and third countries connected to the European Research Area. The project covered all transport modes and focused on the evaluation of the research potential and results in each mode.

The paper summarises the comprehensive evaluation of rail research capabilities of analysed countries, which aimed to identify the main actors who can make an active contribution to the common rail research objectives, and their representative results. The evaluation employed both qualitative and quantitative methods to assess the essential constituents of both major aspects concerning the research capability, i.e. the existing potential and results achieved by rail research in each country. National policies, research organisations and researchers, as well as their results in rail research, were identified, analysed and compared.

Finally, taking into consideration all relevant findings, the research work is offering recommendations addressed both to transport research policy makers (national and European), and to rail researchers.

© 2012 Published by Elsevier Ltd. Selection and/or peer review under responsibility of the Programme Committee of the Transport Research Arena 2012 Open access under CC BY-NC-ND license.

Keywords: rail research, New Member States, research potential, research results, research policy

1. Introduction

FP7 project TransNEW covered all the transport modes and aimed to evaluate research capability in order to support the involvement of New Member States in a number of transport research topics. Through modes evaluation, TransNEW has assessed the research actors who can make an active contribution to the common transport research objectives of advancing competitiveness, anticipating and

* Corresponding author. Tel.: +44-191-222-3971; fax: +44-191-222-8600.
E-mail address: cristian.ulianov@ncl.ac.uk.

1877-0428 © 2012 Published by Elsevier Ltd. Selection and/or peer review under responsibility of the Programme Committee of the Transport Research Arena 2012 Open access under CC BY-NC-ND license.
doi:10.1016/j.sbspro.2012.06.1313

responding to the socio-economic and environmental challenges of the transport system.

This paper summarises the results of the assessment of research capabilities in the rail mode. Both the research results and potential were analysed and compared to evaluate the overall research capability of each country and region, in European context.

The *"New Member States"* concept was used both in the title and within the content of this report; its meaning was purposely enlarged in TransNEW project, covering different categories of countries recently connected to the European Research Area (ERA). Thus, the research work here reported has considered the wider group of ***"New Member States"*** in ERA context, consisting of:

- EU 12 countries - the New Member States of EU, which joined the EU between 2004 and 2007: *Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia*;
- The group of associated states to the European research (i.e., FP7) which are also candidates to the EU: *Albania, Bosnia & Herzegovina, Croatia, FYR of Macedonia, Montenegro, Serbia and Turkey*;
- Third countries cooperating to ERA and neighbouring countries from the first two categories: *Kosovo and Moldova* (Moldova officially became associated country during the project, in 2011).

Organisations with rail research capability and their individual research projects were identified and analysed. For each rail research project the relationship of the results to the European Commission activities has been undertaken. The evaluation work has engaged with the stakeholders by directly involving ERRAC, the rail mode platform, and the Rail Associations. These organisations will benefit from increased knowledge of the research capabilities in New Members States.

2. Evaluation Methodology

In order to assess the research capabilities in rail mode, TransNEW project developed an evaluation methodology, which is resumed in Table 1 below. Considering the state-of-the-art principles and procedures used to evaluate the scientific achievements and research results, the methodology developed and defined evaluation indicators targeting the specific objectives of this evaluation.

The assessment focused on ***two major directions***, as shown in Table 1:

- Evaluation of potential in rail research;
- Evaluation of results of rail research.

2.1. Methodology for Evaluation of Potential in Rail Mode Research

The methodology is looking to cover the assessment of the most important aspects which characterise the research potential of each country. These include the following:

- *National context* (with specific reference to the rail mode) – to determine both the demand for rail research and the available facilities and possibilities. This had to consider:
  a. Transport policies and strategy with relevance to the rail sector (legal framework, planned developments, priority topics etc.);
  b. Research policies with relevance to transport/rail research (priority areas, funding schemes, etc.);
- *Reference organisations* with expertise in rail research or capable of being involved in such activity (all categories, from rail industry, authorities, general transport research institutions, etc.);
- *Researchers* specialised in rail mode, which were identified and included in TransNEW database.
- *Other national achievements and facilities* representative of rail mode research (networks, platforms, education, conferences, journals etc.).

The assessment methods used both qualitative and quantitative indicators, as appropriate.

Table 1. TransNEW – RAIL MODE EVALUATION methodology

CONCLUSIONS & RECOMMENDATIONS	**National level:** • *Conclusions on national capabilities (both in terms of potential and results);* • *Recommendations on national priorities and their compatibility with the transport national plan and research policies;* • *Recommendations on possible developments in some areas*	**Regional level:** • *General conclusions on capabilities which apply to regional level;* • *Recommendations on possible developments and collaborations – clusters, large projects, platforms etc. (according to the regional capabilities and priorities).*	**European level** • *The same as for regional level, but at European level, with focus on new countries (subjects of TransNew).*
OPPORTUNITIES	**National:** *With respect to the national transport system, institutional structure etc.* **Regional:** *To liaise with the regional reports.* **European (and international)** *With respect to related aspects characteristic to both the analysed countries and EU15*	**Highlights:** *Areas of interest (strengths and weaknesses);* *National priorities (related to national plans and research policies)*	
RESULTS	**Subjects** ✓ *Research Projects;* ✓ *Collaborations (platforms, excellence centres etc.);* ✓ *Other representative work (scientific, dissemination, education etc.)*	**Criteria:** ✓ *quantitative;* ✓ *qualitative.* Projects impacts will be mainly evaluated, using similar procedures as used by European institutions.	
POTENTIAL	**Subjects:** ✓ *Institutional structure (as evaluated by countries reports);* ✓ *Organisations;* ✓ *Researchers.*	**Criteria:** ✓ *quantitative;* ✓ *qualitative.*	
SUPPORT	**Scientific and research evaluation** ✓ *Objectives;* ✓ *State-of-the-art;*	✓ *Scientific evaluation indicators;* ✓ *Methodology.*	

BALTIC STATES			CENTRAL EUROPE				WEST BALKANS							SOUTH BALKANS AND MEDITERRANEAN						
Estonia	Latvia	Lithuania	Czech Republic	Estonia	Latvia	Lithuania	Bosnia - Herzegovina	Croatia	Kosovo	FYR Macedonia	Montenegro	Serbia	Slovenia	Albania	Bulgaria	Cyprus	Malta	Moldova	Romania	Turkey

A. Qualitative Method

The qualitative method used the above criteria, which have been separately assessed using qualitative indicators (STRONG, MEDIUM and WEAK, defined in Table 2 below). Considering the indicators awarded to each criterion, the overall potential in rail research was evaluated for each country using the same indicators.

B. Quantitative Method

In order to evaluate more accurately and allow comparisons between the analysed countries, a conventional, general ***research potential indicator*** is proposed. Considering the main measurable factors influencing the potential in rail research as mentioned above, an ***absolute value of the conventional research potential indicator*** for rail area can be roughly determined using the following formula:

$$RPI_{Ra} = \eta_{RR}(N_{RR} + k_{TR}N_{TR})[1 + k_{RO}(N_{RO} - 1)] \quad (1)$$

where:

RPI_{Ra} – conventional indicator of the potential of rail research in a country or region (absolute value);

N_{RR} – number of active researchers specialised in rail research;

N_{TR} - number of other active transport researchers (general transport, multimodal, logistics, etc.) with capability to involve in rail research;

k_{TR} – weighted coefficient to correlate the potential of transport researchers with some capabilities in rail research (N_{TR}) with those having expertise in the area (N_{RR});

Table 2. Definitions of the qualitative indicators proposed for the assessment criteria of rail research potential

a. National context	
STRONG	Where the national situation is highly favourable to rail research with regard to all influencing aspects: - A real demand for rail research reflected by a coherent policy and strategy in the area, ongoing and planned developments and investments, etc. - An efficient research policy coordinated by well organised institutional structure. Transport (rail) research should be part of national research priorities. - Good level of R&D funding (in general and/or for rail research)
MEDIUM	Where at least one of the influencing factors above is not favourable to rail research. However, the overall conditions are still favourable.
WEAK	Where all the influencing factors above are unfavourable to rail research; rail research is not encouraged and supported at any level.
b. Representative organisations	
STRONG	Characterised by: - active rail research organisations at national level; - involvement of public bodies/authorities in research; - representative numbers of research units/centres in all categories (universities/research institutions, industry, private companies, etc.)
MEDIUM	Where at least one (maximum two) of the characteristics above exists. There are some organisations with capabilities in rail research, but not in all levels/categories.
WEAK	Characterised by a much reduced number of organisations involved in rail research; none of the characteristics above apply.
c. Researchers specialised in rail mode	
STRONG	Characterised by a large number of researchers specialised in rail or having some interest in rail research, acting in various types of organisations (universities/research institutes, industry, private companies, etc.). A strong railway engineering educational base is usually needed for this.
MEDIUM	Defined by a lower number of researchers acting in rail research, in a reduced number of organisations. Sometimes there could be shortcomings in the educational background (in railway engineering).
WEAK	Characterised by a relatively insignificant number of researchers with capabilities in rail research; one of the reasons is usually the gap in railway engineering education (all levels).
Note: The quantitative data defining criteria b and c above (number of researchers and organisations) have been assessed with respect to the demand for rail research and specific geographic and demographic aspects of each country. The figures have also been assessed in comparison with European average level, other modes and characteristics of other similar countries (in terms of area, population, transport volume, etc.)	

N_{RO} – number of organisations identified in a country (region) as acting or capable to get involved in rail research;

k_{RO} – influence coefficient reflecting how a higher number of research organisations is emphasizing the potential and efficiency in a country or region (by competition, collaboration, covering more topics/geographical areas etc.);

η_{RR} – efficiency of the factors determining the potential of rail research in a country (region) depending on the financial resources available in the area; for comparison purposes it can be estimated as:

$$\eta_{RR} = \frac{GDP_{RR}}{GDP_{RR_{av}}} \qquad (2$$

In the equation (2) above GDP_{RR} is the fraction of the gross domestic product (nominal) per capita allocated for rail research, and GDP_{RRav} is the European average level allocated in this research area. If figures for rail research are not available, similar data related to transport research or general R&D

domain (Gross Domestic Expenditure on Research and Development - GERD) could be alternatively used.

The conventional indicator proposed above offers an indicative estimate of the potential in rail research, but the figures used in computing are dependent on the particularities of the analysed country or region. Thus, the absolute value of the proposed indicator needs to be attenuated considering the most influent countries' characteristics, such as the demand for transport (in terms of transport volume), geographical and demographical aspects (area and population). Including all these influences, the indicator RPI_{Ra} defined above can be computed to obtain an efficient value which should allow more accurate comparisons and conclusions.

Considering the main influences above mentioned, an ***efficient value of the conventional research potential indicator*** for rail area is proposed:

$$RPI_{RE} = RPI_{Ra} \cdot \left[\frac{\frac{I_{ft}}{I_{ft_{EUR}}} \cdot \frac{I_{pt}}{I_{pt_{EUR}}}}{\left(k_A \frac{A}{A_{EUR}} + k_P \frac{P + k_{ap} P_a}{P_{EUR}} \right) \cdot 100\%} \right] \quad (3$$

The following notations were used in equation (3):

RPI_{RE} - conventional indicator of the potential of rail research in a country or region (efficient value);

I_{ft} - index of inland freight transport volume relative to GDP (indexed on 2000) for the analysed country;

I_{ftEUR} - index of inland freight transport volume relative to GDP (indexed on 2000) – European level;

I_{pt} - index of inland passenger transport volume relative to GDP (indexed on 2000) for the analysed country;

I_{ptEUR} - index of inland passenger transport volume relative to GDP (indexed on 2000) – European level;

k_A - influence coefficient of the area of the country on the demand for transport, respectively transport research;

k_P - influence coefficient of the population of the country on the demand for transport, respectively transport research;

A – area of he analysed country [sq km];

P – population of the analysed country [1000 inhabitants];

P_a – active population of the analysed country [1000 inhabitants];

A_{EUR} – area of Europe [sq km];

P_{EUR} – population of Europe [1000 inhabitants];

k_{Pa} – influence coefficient reflecting the degree of higher demand for transport of the active population.

The necessary data to determine the absolute and efficient values of the proposed indicator were captured from the countries' spreadsheets produced by TransNEW partners as input for the database, and official statistics as well (European sources such as EUROSTAT have been preferred). In order to achieve reliable indicators, useful for analyses and comparisons, the primary data in the spreadsheets need to be checked again and validated by the institutions producing them. This is a compulsory step in the methodology of qualitative evaluation, otherwise huge discrepancies and unrealistic values might be obtained.

2.2. Methodology for Evaluation of Results in Rail Mode Research

The assessment of results in rail research employed a qualitative method, using similar indicators as defined for the potential assessment. The assessment methodology considered the most important achievements which define the research results of each country, respectively:

- *Research projects* in rail mode (including national, European and private funded projects);
- *Collaborative structures* (such as technology platforms, research platforms, centres of excellence, networks specialised in specific topics/areas of interest, etc.);
- *Other representative results* concerning research in rail mode (journals/papers and other publications, conferences, participation in European/International associations/bodies/authorities, etc.).

Traditional methods employed to evaluate research results (such as projects, scientific publications etc.) have been adapted for the purpose of the mode evaluation. Such evaluation methods are already used by European Technology Platforms to evaluate the research projects' results.

The ***evaluation of the project's results*** has considered and analysed all ***possible implementation of results***, including:

- *Market uptake* (in terms of implementation of technical solutions or input in any regulation – standards, directives, codes etc.);
- *Scientific results* (innovations, novel technical solutions, publications, presentations, etc.);
- *Follow-up projects* (designed to accomplish the implementation of the achievements of the initial project – could be commercial initiatives, as well);
- *Development of collaborative structures* (such as platforms, networks, functional databases etc.);
- *Other implementations* with representative impact (in areas such as environment, social, safety, etc.)

The projects' results were assessed focusing on the market uptake. The qualitative indicators defined below and used to describe projects' results have been defined following the model of those used by ERRAC's Evaluation Working Group:

- ***STRONG*** – a project was evaluated with strong results if there is clear evidence of any implementation (as defined above) in several countries/products and the majority of the objectives of the project have been achieved.
- ***MEDIUM*** – a project was evaluated with medium results if there is some evidence of implementation in a few countries, products, regulation or other relevant results presented above (scientific results, successful follow-up projects or functional collaborative structures). If only a small proportion of project outcomes have some implementation, the project as a whole is considered to have a medium market uptake.
- ***WEAK*** – a project was evaluated with weak results if no known implementation (in products, processes, dissemination of knowledge, or other results as above) has been identified nowhere and the overall project results are rather irrelevant.

The most representative ***collaborative structures*** and ***other relevant results*** were also identified in each country, analysed and assessed using a similar qualitative method. The assessment was made with respect to both the average European level of such results and the similar achievements of other considered countries (for comparison reasons).

3. Evaluation of the Potential in Rail Mode Research

Following the methodology described in the previous section, the rail research potential was analysed in the New Member States. The analysis was based on the project deliverables on countries capabilities in transport research (in references), as primary information sources, which were further supplemented with updated data provided by the partners who carried out the countries studies, or from other reliable, direct

sources such as researches from the analysed countries (ERAWATCH reports and others, in references), official websites, statistics, etc.

3.1. Qualitative Evaluation

The summary of the overall potential of rail research evaluated for each analysed country in respect with all considered criteria, along with the similar assessment of results, is presented at the end of section 3, in Table 5. More detailed information and comments supporting the countries potential and results evaluations were reported in TransNEW deliverable.

3.2. Quantitative Evaluation

Following the methodology detailed in previous section, the conventional research potential indicators were calculated for each country using data from the spreadsheets, collected during the project. Statistical data were also used to take into account the demand for rail research and geographical and demographical characteristics of each country. The absolute and efficient values of the conventional research indicator were determined with formulas (1), respectively (3) and are presented in Table 3 below.

Table 3. Quantitative evaluation of the potential in rail research of New Member States

Country	N_{RR}	N_{TR}	N_{RO}	RPI_{Ra}	RPI_{RE}
BALTIC STATES					
Estonia	0	11	2	**2.80**	**4.49**
Latvia	12	21	22	**21.78**	**61.80**
Lithuania	6	32	11	**19.56**	**55.33**
CENTRAL EUROPE					
Czech Republic	16	121	26	**238.86**	**130.94**
Hungary	14	35	9	**36.45**	**27.21**
Poland	8	1	4	**3.90**	**1.21**
Slovakia	11	99	17	**40.82**	**34.58**
WEST BALKANS					
Bosnia –Herzegovina	8	18	11	**0.60**	**X**
Croatia	0	19	4	**3.81**	**X**
Kosovo	0	0	0	**X**	**X**
FYR Macedonia	1	0	1	**0.09**	**0.47**
Montenegro	0	0	0	**X**	**X**
Serbia	49	0	8	**23.40**	**X**
Slovenia	8	6	2	**3.11**	**15.47**
SOUTH BALKANS AND MEDITERRANEAN					
Albania	2	0	2	**0.24**	**X**
Bulgaria	54	37	17	**72.10**	**65.35**
Cyprus	1	0	1	**0.23**	**0**
Malta	0	0	0	**0**	**0**
Moldova	0	1	1	**0.08**	**X**
Romania	28	65	26	**68.06**	**29.00**
Turkey	4	3	6	**3.56**	**0.30**

Note: the notations used above:

N_{RR} – no. of researchers specialised just in rail in each country, as identified by TransNEW country reports;
N_{TR} – no. of national transport researchers with some interest in rail (others than those above), identified within the countries reports;
N_{RO} – no. of research organisations with rail research interest and activities, as identified in countries reports;
P_{RR} – overall potential in rail research (determined for comparison purposes using TransNEW methodology);
PE_{RR} – effective potential in rail research (determined for comparison purposes using TransNEW methodology);
X – no result (data could not be computed due to the lack of information)

It was remarked that this evaluation is totally dependent on the accuracy of the information gathered by project partners as part of the analysis of transport research capabilities of each New Member State. For this reason, in order to validate the results of this quantitative evaluation, the data included in the countries' spreadsheets need to be completed and validated, as well.

A primary analysis of the conventional indicators shows that, roughly, the figures determined using the available data are consistent with the qualitative indicators assessed in the previous section. However, in some cases (the figures in red font in Table 3) the quantitative assessment indicates different levels of potential in rail research in comparison with the qualitative evaluation. It is very likely that these differences have resulted from computing less accurate data, which may be caused by different issues such as missing information, over-evaluated information, or wrong inputs.

3.3. Synthesis of Results and Conclusions

Considering the overall level of the potential in rail research, the countries could be clustered in three groups, as shown in Table 4 below. The countries are also grouped on regions for each level of potential.

The graphical representation on Europe map, Figure 1, is very relevant in drawing the rail research potential on geographical regions.

Table 4. New Member States by overall level of rail research potential

Overall rail research potential	Region / Country	No. countries
STRONG	***CENTRAL EUROPE:*** Czech Republic, Poland, Slovakia	**3**
MEDIUM	***BALTIC STATES:*** Latvia, Lithuania ***CENTRAL EUROPE:*** Hungary ***WEST BALKANS:*** Serbia, Slovenia ***SOUTH BALKANS AND MEDITERRANEAN:*** Bulgaria, Romania	**7**
WEAK	***BALTIC STATES:*** Estonia ***WEST BALKANS:*** Bosnia –Herzegovina, Croatia, Kosovo, FYR Macedonia, Montenegro ***SOUTH BALKANS AND MEDITERRANEAN:*** Albania, Cyprus, Malta, Moldova, Turkey	**11**

The comparative analysis of the assessments presented in the previous sections allows some specific ***conclusions regarding the potential in rail mode research*** of analysed countries. The most relevant findings are presented below.

- There are significant differences regarding the historical background in rail sector between the analysed countries. While some countries such as Czech Republic, Slovakia, Poland, Romania, Bulgaria, and Serbia have a strong background and tradition in rail industry, services and education, the interest in this domain was very low in other countries since the beginning of the railway history, due mainly to geographical and economic conditions.
- The rail system is non-existent in two of the analysed countries, Cyprus and Malta. There were some railway initiatives on these two islands at the beginning of the 20th century, which were abandoned due to the low efficiency of the developed systems. In such conditions, the research potential in rail transport is obviously non-existent and was formally considered as WEAK.
- The rail networks of some of the analysed countries were part of the same bigger networks of former federative countries. Due to the particularities of rail infrastructure (related to interoperability, communications, signalling, etc.), there are still very strong links between the rail networks in countries from former USSR (Baltic States and Moldova), respectively from former Yugoslavia (Serbia, Slovenia, Montenegro, Croatia, Bosnia-Herzegovina, FYR Macedonia and Kosovo). Thus, the rail research should focus on similar existing problems, the collaboration between organisations of these countries being strictly necessary. Joint actions carried out by multi-national research teams

would have a much higher efficiency and success in solving the existing regional problems.

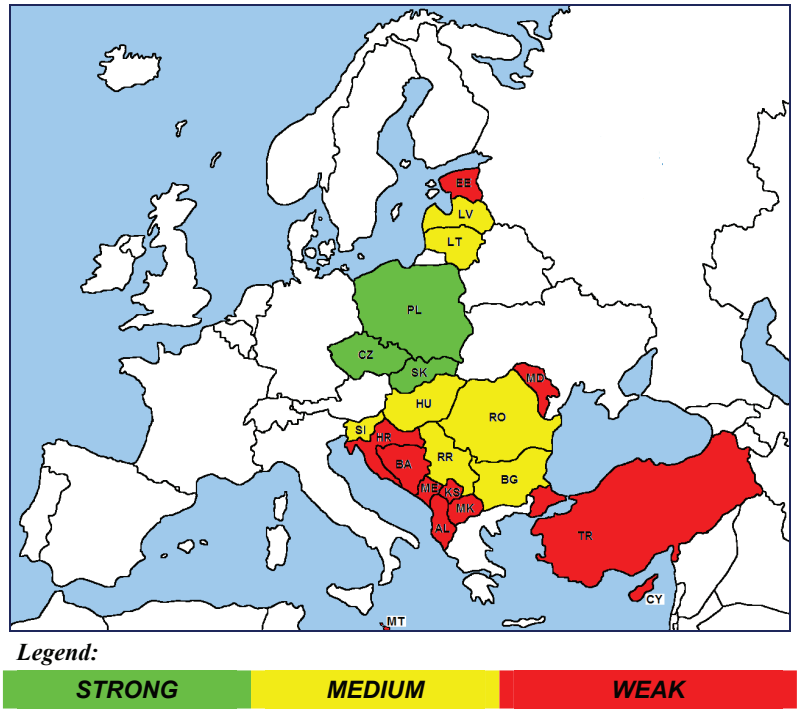

Fig. 1. Potential in rail research – TransNEW analysed countries in Europe

- Rail research potential was evaluated as STRONG in 3 out 4 countries in Central Europe region. This could be justified by a strong, traditional rail industry, a significant mass of experts and professionals, the vicinity of Western developed countries, the strategic position in Europe, and many other factors.
- Rail research potential was evaluated as weak in most of West Balkans countries, Turkey and countries from former USSR (Estonia and Moldova). All these countries are geographically situated at the extremes of the analysed regions, bordering more or less Europe. This could explain in a certain measure the lower economic impact and importance of rail sector in these countries. Since the rail sector was and still is neglected, the research in this domain cannot develop and achieve good results.
- Most of the analysed countries have had communist regimes in the near past, and suffered major economic and social transformations in the last two decades. Issues such as brain drain, poor transfer of knowledge, obsolete and poor condition research infrastructure, small incomes, etc. are also influencing in the most negative way the potential in research in general, particularly in rail research.
- The involvement in rail research of different categories of organisations varies very much from a country to another. In countries such Czech Republic, Poland, or Slovakia both state institutions and the private sector are active at national and European level. Meanwhile, in smaller countries, with a weak rail sector (e.g., West Balkans countries, Albania, Moldova), some basic research is carried out by state owned organisations, while the private initiatives are less visible or even non-existent.
- Turkey is a non-specific case regarding the rail sector and associated research. Despite the large country size and population, the rail sector was historically neglected. In such conditions, the rail research potential is weak and under developed. However, due to the significant economic growth in the last years, and the perspective of integration in the EU, rail sector became a high priority. Thus, the

national context improved, being more favourable to rail research, but the major gaps in rail education, number of rail experts and research organisations, poor research infrastructure, etc. need more time to be solved.

Table 5. Summary of rail research evaluation (potential and results)

No	Country	Rail research potential				Rail research results			
		National Context	*Researchers*	*Organisations*	Overall	*Projects*	*Collaboration*	*Other*	Overall
BALTIC STATES									
1.	Estonia	*M*	*W*	*W*	***WEAK***	*W*	*W*	*W*	***WEAK***
2.	Latvia	*M*	*M*	*S*	***MEDIUM***	*W*	*W*	*W*	***WEAK***
3.	Lithuania	*M*	*M*	*M*	***MEDIUM***	*W*	*W*	*M*	***WEAK***
CENTRAL EUROPE									
4.	Czech Republic	*M*	*S*	*S*	***STRONG***	*S*	*S*	*M*	***STRONG***
5.	Hungary	*M*	*M*	*M*	***MEDIUM***	*M*	*W*	*W*	***WEAK***
6.	Poland	*M*	*S*	*S*	***STRONG***	*S*	*M*	*M*	***MEDIUM***
7.	Slovakia	*M*	*S*	*S*	***STRONG***	*S*	*M*	*M*	***MEDIUM***
WEST BALKANS									
8.	Bosnia –Herzegovina	*W*	*M*	*W*	***WEAK***	*W*	*W*	*W*	***WEAK***
9.	Croatia	*M*	*W*	*W*	***WEAK***	*W*	*W*	*W*	***WEAK***
10.	Kosovo	*W*	*W*	*W*	***WEAK***	*W*	*W*	*W*	***WEAK***
11.	FYR Macedonia	*W*	*W*	*W*	***WEAK***	*W*	*W*	*W*	***WEAK***
12.	Montenegro	*W*	*W*	*W*	***WEAK***	*W*	*W*	*W*	***WEAK***
13.	Serbia	*M*	*M*	*W*	***MEDIUM***	*W*	*W*	*M*	***WEAK***
14.	Slovenia	*M*	*M*	*W*	***MEDIUM***	*M*	*M*	*M*	***MEDIUM***
SOUTH BALKANS AND MEDITERRANEAN									
15.	Albania	*W*	*W*	*W*	***WEAK***	*W*	*W*	*W*	***WEAK***
16.	Bulgaria	*M*	*M*	*M*	***MEDIUM***	*M*	*W*	*M*	***MEDIUM***
17.	Cyprus	*W*	*W*	*W*	***WEAK***	*W*	*W*	*W*	***WEAK***
18.	Malta	*W*	*W*	*W*	***WEAK***	*W*	*W*	*W*	***WEAK***
19.	Moldova	*M*	*W*	*W*	***WEAK***	*W*	*W*	*W*	***WEAK***
20.	Romania	*M*	*S*	*M*	***MEDIUM***	*W*	*M*	*M*	***MEDIUM***
21.	Turkey	*M*	*W*	*W*	***WEAK***	*W*	*W*	*W*	***WEAK***
Legend:		*W*	***WEAK***	***M***	***MEDIUM***	***S***		***STRONG***	

Note: ***All the evaluations above*** were made in comparison with the average results of EU27, including the rail research results of high developed countries, with strong tradition and background in rail area.

4. Evaluation of the Results in Rail Mode Research

4.1. Research Results in Rail Mode in TransNEW Countries

Following the methodology described in previous section, the most representative projects were selected and evaluated. The results of each New Member State were assessed according to the number of projects in the rail mode and their quality. Research results which further materialised in collaborative structures such as platforms, centres of excellence, networks, etc. were also identified and assessed for each country. Finally, other representative research results in rail mode, which could not be considered for the previous assessments, were evaluated according to the methodology. Results such as representative publications, conferences, participation in European or International associations, bodies, authorities, etc. were considered for this criterion.

The overall rail research results were evaluated using a similar qualitative indicator resulted as a weighted average (with more focus on projects) of the indicators for each criterion. The summary of all evaluations made is presented in Table 5 above.

Considering the overall levels of results achieved in rail research, the analysed TransNEW countries were clustered on three groups, as shown in Table 6 below. The graphical representation on Europe map, Figure 2, is even more representative in showing the rail research results on geographical regions.

Table 6. New Member States by overall level of results achieved in rail research

Overall rail research potential	Region / Country	No. countries
STRONG	***CENTRAL EUROPE:*** Czech Republic	**1**
MEDIUM	***CENTRAL EUROPE:*** Poland, Slovakia ***WEST BALKANS:*** Slovenia ***SOUTH BALKANS AND MEDITERRANEAN:*** Bulgaria, Romania	**5**
WEAK	***BALTIC STATES:*** Estonia, Latvia, Lithuania ***CENTRAL EUROPE:*** Hungary ***WEST BALKANS:*** Bosnia –Herzegovina, Croatia, Kosovo, FYR Macedonia, Montenegro, Serbia ***SOUTH BALKANS AND MEDITERRANEAN:*** Albania, Cyprus, Malta, Moldova, Turkey	**15**

Specific ***conclusions regarding the rail research results*** in analysed countries are presented below.

- The evaluation of rail research results was made taking into account similar results in all EU countries. This is the main reason why the results in New Member States were considered rather weak and medium in some cases, with a single exception (strong in Czech Republic).
- There are no essential discrepancies between the research potentials and results evaluated in previous sections. The comparison between the rail research potential and results achieved in the last 20 years, highlighted in Table 5, confirms that the results are consistent with the potential in most of the analysed countries. However, in some cases the results are weaker than the potential (e.g., WEAK results vs. MEDIUM potential in Latvia, Lithuania, Hungary and Serbia, and MEDIUM results vs. STRONG potential in Poland and Slovakia).
- The single country with STRONG rail research results, comparable with those achieved in developed European countries, is the Czech Republic. Their involvement in European projects is remarkable, both the state institutions and private sector being very active in rail research. They also benefit of a very well organised national technologic platform, enhancing the collaboration between Czech institutions.
- Unfortunately, rail research results in the large majority of analysed countries have been assessed as WEAK (15 out of 21, respectively 71%). Most of West and South Balkans countries and all Baltic States have achieved weak results in rail research in the last years. Their involvement and efforts are very poor, negligible in some cases, both at national and European level.
- The very poor participation of several countries in European projects is not unexpected for countries with weak potential (such as Estonia, Bosnia-Herzegovina, Croatia, Kosovo, FYR Macedonia, Montenegro, Albania, Cyprus, Malta, Moldova, and Turkey). However Latvia, Lithuania, Hungary and Serbia, which were evaluated with medium potential, also show weak participation in European and national projects and have overall weak results. Considering their potential, researchers in these countries would be more successful with the support of European technology platforms, and trying to join more European initiatives.

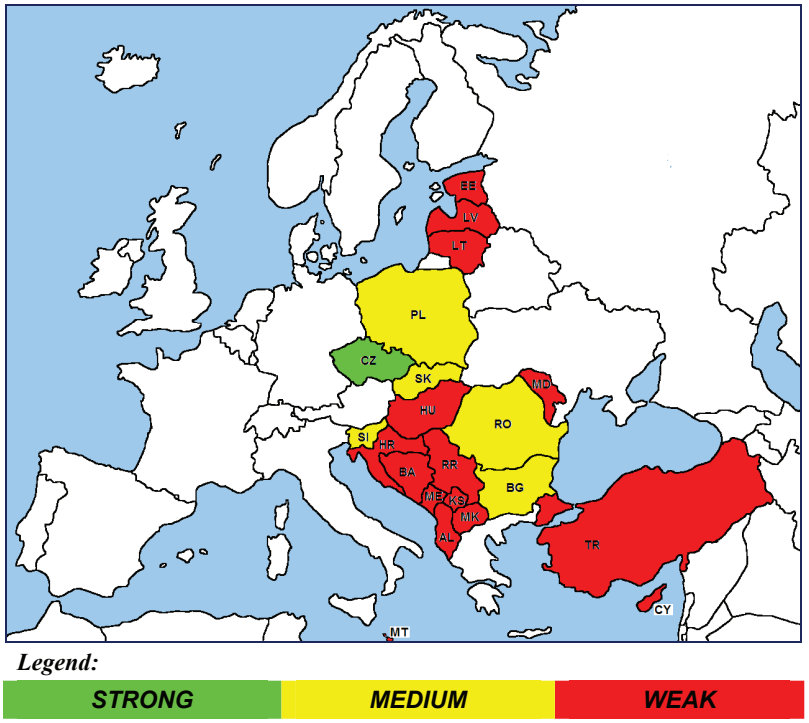

Fig. 2. Overall results in rail research – TransNEW analysed countries in Europe

- An easy, but efficient step towards the achievement of more relevant rail research results in countries with medium and strong potential would be the organising and hosting of important national and international events, rail research conferences, workshops, symposiums, which could create links between the national researchers and their international counterparts.

5. General Conclusions and Recommendations

The final conclusions consider both the national and regional contexts. At a first glance, it seems that there are many differences between national rail research policies, institutional systems, research topics and priorities.

Taking this into account and looking into the programmes and ERRAC Strategic Rail Research Agenda (SRRA) (ERRAC, 2002, 2007), the similarities between the national programmes, as well as the coverage of these issues by the SRRA could be analysed.

Some ***general observations regarding the national programmes*** can be made:

- All national programmes are pre-competitive, cost-shared and open to all stakeholders, including academics. In general, authorities are anxious to promote innovation and encourage synergies between SMEs, academics, big companies and other stakeholders.
- The programmes are mainly dealing with transport issues in general; there are not specific rail oriented schemes. The statements and actions included in the overall national transport strategy or policy should be based on the sustainability rules, reflecting the balance between different transport modes.
- The practicalities, provisions, submission procedures and expected outcomes of the National

programmes vary from one country to another. This fragmentation is related to the structure of research and the financing of research in each country.

- The rail funding budgets are difficult to assess because not all programmes focus on rail. In addition, the support allocated to each project is very different from one country to another for various reasons. On top of that, the national programmes have varying time scales.
- National programmes are generally, to some extent, influenced by EU strategies and policies, and the RTD work programme regarding research in transport systems in Europe.
- Most of the countries seem to be attracted by the funding under the European Framework programmes (FP5-7), since they encourage the national stakeholders to submit or join proposals.

Some ***general conclusions*** are summarised below.

- The highest potential and best results were identified in the Central Europe region (i.e., Czech Republic, Slovakia and Poland). The countries in this region have a favourable geographical position and remarkable historical background and achievements.
- The rail system is non-existent, being abandoned, in two island countries, Cyprus and Malta. However, it was formally assessed as WEAK, to avoid introducing another indicator (such as non-existent).
- Some smaller countries without tradition and expertise in rail domain (e.g., Albania, Kosovo, Montenegro, and Moldova) evaluated with WEAK potential and results have reduced chances to improve their capabilities in rail research in the near future due to serious gaps and problems in rail sector, rail education, lack of funding, etc.
- Other countries evaluated with WEAK potential and results (i.e., Estonia, Bosnia -Herzegovina, Croatia, FYR Macedonia and Turkey) have real premises to improve their capabilities, especially with the support of national authorities.
- Most of the countries evaluated with MEDIUM (Latvia, Lithuania, Hungary, Romania, Bulgaria, Slovenia and Serbia) have also considerable conditions to improve their potential and mainly results.
- In order to reduce the discrepancy between the capabilities in rail research of most of the analysed countries and high developed European countries, both the policy makers and researchers from New Member States should make efforts to improve the potential through the quality of people, better organisation of institutions, improvement of collaboration and education.

Based on the report findings, this final section presents also some recommendations regarding both the research policy and research activities related to rail transport mode. However as the evaluated potentials and results varies significantly, the recommendations might not be applicable to all analysed countries.

Recommendations on research policy *(addressed to national and European policymakers):*

- A better adjustment of the research policies and priorities with special reference to the rail sector, according to ERRAC Strategic Rail Research Agenda, SRRA.
- Some countries should finalise their research agendas with special consideration of the gaps and problems of their national transport system, between supply and demand (focusing on railway system, as European priority). Development of general transport research policies, covering all modes of transport and eliminating current gaps in research areas should be considered.
- In some countries, policymakers should make efforts to eliminate the existing shortcomings in the rail engineering educational system, in order to ensure a permanent source of high quality experts.
- The funding procedures need to be improved in some New Member States to increase the efficiency of this process (available for all research areas in those countries). Sometimes the bureaucratic issues are real hindrances to researchers from all types of organisations trying to achieve funding for their work.
- Policymakers from all New Member States have to improve urgently the implementation of rail research results. The implementation of the results achieved in rail research would have even a greater

impact in the New Member States, where the rail sector is suffering much more nowadays due to both the recent changes and recession. European best practices should be followed.

- Due to the strategic importance of the rail system, the transport and research policies need to provide efficient tools to encourage the private-public partnership in rail sector and associated research. The newborn private companies acting both in rail industry and services should benefit from a favourable framework to get more involved in research activities.
- Public authorities should pay more attention to research collaboration with RTD Performers, especially in research for public institutions programmes. This would enhance the level of cooperation and create a PPP (private public partnership) model in the industry.
- Improvement or set up of rail education (engineering, logistic and economics, at all levels), mainly in countries with big gaps (e.g., Albania, Moldova, Montenegro, Estonia, Turkey, etc.).

Technical recommendations *(addressed to researchers in rail mode)*

- Rail researchers should adapt the national and regional rail research priorities according to European priorities and strategies, as included in ERRAC Strategic Rail Research Agenda (SRRA).
- New Member States should improve their international (especially European) collaborations in rail research. The experts from countries identified with weak results in rail research need to make efforts to be more active to participate in EU projects, European associations and professional bodies.
- Rail researchers from New Member States should also improve their active participation in the thematic European workshops and events related to rail transport.
- National professional associations should have a more active role in disseminating information regarding research programmes, determining research policies, clustering activities and deployment of new technologies in industry.
- All priority rail topics (i.e., sustainability, greening, competitiveness, etc.) should be approached more balanced, both at national level and in European projects.
- Rail researchers should be more active and visible at European level. This would improve the collaborations, being useful both for researchers looking for projects and possible investors looking for researchers for specific activities.
- Researchers should improve the impact of their research outcomes, mainly at national level. Implementation of results in commercial applications, standards and other regulations have the most efficient and visible impact.
- Enhancement of bilateral R&D rail oriented agreements established between TransNEW countries.
- Set up of competitive excellence centres at national and international scale and dense networks of universities and public research bodies specialised in rail transport, at national level.
- Improvement of collaboration for solving immediate existing issues, between organisations from countries having rail networks with similar problems, coming from the same bigger network (i.e., former Yugoslavia and former USSR countries).
- Development of the European dimension of research careers, opportunities of going ahead, particularly through a transnational opening of available jobs, elimination of institutional and national barriers, providing the researchers larger financing opportunities. An EU common research career definition.

Acknowledgements

The authors would like to acknowledge for the financial support offered by TransNEW project, FPT-TPT-2008.8-RTD-1, a Support Action within theme TPT.2008.8 of FP7.

References (selected)

Baláž, V. (2011). Analytical country report (2010): Slovakia. *ERAWATCH*: European Commission DG for Research.

Božičnik, S., Marksel, M., Hanžič, K., & Letnik, T. (2011). Deliverable D3.2 – Transport research capability in Croatia. *TransNEW project, FP7* University of Maribor, Slovenia.

Bučar, M. (2011). Analytical country report (2010): Slovenia. *ERAWATCH*: European Commission DG for Research.

Constantin, I., Cernat-Gruici, B., & Caraman, D. (2011). Deliverable D4.5 – Transport research capability in Cyprus. *TransNEW project, FP7* Integral Consulting R&D (INTECO), Romania.

Constantin, I., & Cernat, B. (2011). Deliverable D4.2 – Transport research capability in Romania. *TransNEW project, FP7* Integral Consulting R&D (INTECO), Romania.

Damianova, Z., Galev, T., Georgieva, T., Mineva, D., & Stefanov, R. (2011). Analytical country report (2010): Bulgaria. *ERAWATCH*: European Commission DG for Research.

Elci, S. (2011). Analytical country report (2010): Turkey. *ERAWATCH*: European Commission DG for Research.

Ene, I., Ceban, D., & Robinson, M. (2011). Deliverable D4.7 – Transport research capability in Republic of Moldova. *TransNEW project, FP7* Research and Educational Networking Association of Moldova (RENAM), Newcastle University, UK.

ERRAC. (2002). Strategic Rail Research Agenda 2020 (SRRA). First Report of the European Rail Research Advisory Council: European Rail Research Advisory Council (ERRAC).

ERRAC. (2007). Strategic Rail Research Agenda 2020 (SRRA). Updated version: European Rail Research Advisory Council (ERRAC).

ERRAC. (2008). A comparison of European public research programmes with the ERRAC SRRA 2020: European Rail Research Advisory Council (ERRAC).

Georgieva, M., & Topalov, I. (2011). Deliverable D4.4 – Transport research capability in Bulgaria. *TransNEW project, FP7* "Todor Kableshkov" Higher School of Transport Sofia, Bulgaria.

Hanžič, K., Božičnik, S., & Letnik, T. (2011). Deliverable D3.5 – Transport research capability in Kosovo. *TransNEW project, FP7* Faculty of Civil Engineering, University of Maribor, Slovenia.

Havas, A. (2011). Analytical country report (2010): Hungary. *ERAWATCH*: European Commission DG for Research.

Hebakova, L., & Valenta, O. (2011). Analytical country report (2010): Czech Republic. *ERAWATCH*: European Commission DG for Research.

Jahic, E. (2011a). Analytical country report (2010): Bosnia-Herzegovina. *ERAWATCH*: European Commission DG for Research.

Jahic, E. (2011b). Analytical country report (2010): Montenegro. *ERAWATCH*: European Commission DG for Research.

Jaržemskis, A., Barysienė, J., Jarzemskis, V., & Markucevičiūtė, I. (2011). Deliverable D1.1 – Transport research capability in the Lithuania. *TransNEW project, FP7* Vilnius Gediminas Technical University, Lithuania.

Jaržemskis, A., Jarzemskis, V., & Markucevičiūtė, I. (2011). Deliverable D1.3 – Transport research capability in the Estonia. *TransNEW project, FP7* Vilnius Gediminas Technical University, Lithuania.

Jerzyniak, T. (2011). Analytical country report (2010): Poland. *ERAWATCH*: European Commission DG for Research.

Josimovski, S. (2011). Analytical country report (2010): FYR Macedonia. *ERAWATCH*: European Commission DG for Research.

Kalniņš, K., Čate, A., Kampeniuss, M., & Labans, E. (2011). Deliverable D1.2 – Transport research capability in the Latvia. *TransNEW project, FP7* Riga Technical University, Latvia.

Kocur, F., Kajánek, P., & Šedivý, Š. (2011). Deliverable D2.4 – Transport research capability in Slovakia. *TransNEW project, FP7* VÚD a.s., Žilina, Slovakia (on behalf of CDV Transport Research Centre, Czech Republic).

Kristapsons, J., Adamsone-Fiskovica, A., & Draveniece, A. (2011). Analytical country report (2010): Latvia. *ERAWATCH*: European Commission DG for Research.

Kutlaca, D. (2011). Analytical country report (2010): Serbia. *ERAWATCH*: European Commission DG for Research.

Meško, M., Nacev, T., & Gamberger Lončarič, P. (2011). Deliverable D3.1 – Transport research capability in Slovenia. *TransNEW project, FP7* Slovenia Control Ltd., Slovenia.

Milković, D., & Lučanin, V. (2011a). Deliverable D3.3 – Transport research capability in Serbia. *TransNEW project, FP7* Faculty of Mechanical Engineering, University of Belgrade, Serbia.

Milković, D., & Lučanin, V. (2011b). Deliverable D3.4 – Transport research capability in Bosnia-Herzegovina. *TransNEW project, FP7* University of Belgrade, Serbia.

Milković, D., & Lučanin, V. (2011c). Deliverable D3.6 – Transport research capability in Montenegro. *TransNEW project, FP7* Faculty of Mechanical Engineering, University of Belgrade, Serbia.

National background reportson transport. (2009) *Co-ordination of Research Policies with the Western Balkan Countries*: WBC-INCO.NET.

Ozan, O. G., Melik, S., & Koru, A. (2011). Deliverable D4.1 – Transport research capability in Turkey. *TransNEW project, FP7* The Scientific and Technological Research Council of Turkey (TUBITAK), Turkey.

Paliokaitė, A. (2011). Analytical country report (2010): Lithuania. *ERAWATCH*: European Commission DG for Research.

Preci, Z. (2011). Analytical country report (2010): Albania. *ERAWATCH*: European Commission DG for Research.

Ranga, M. (2011). Analytical country report (2010): Romania. *ERAWATCH*: European Commission DG for Research.

Rannala, R., & Männik, K. (2011). Analytical country report (2010): Estonia. *ERAWATCH*: European Commission DG for Research.

Razbornik, F., Marksel, M., Hanžič, K., & Štiglic, M. (2011). Deliverable D3.7 – Transport research capability in FYR Macedonia. *TransNEW project, FP7* Faculty of Civil Engineering, University of Maribor, Slovenia.

Spiesberger, M., & Cuciureanu, G. (2011). Analytical country report (2010): Moldova. *ERAWATCH*: European Commission DG for Research.

Spousta, J., & Gelova, E. (2011). Deliverable D2.1 – Transport research capability in the Czech Republic. *TransNEW project, FP7* CDV Transport Research Centre, Czech Republic.

Švarc, J., & Račić, D. (2011). Analytical country report (2010): Croatia. *ERAWATCH*: European Commission DG for Research.

Tos, A. K. (2011). Deliverable D4.3 – Transport research capability in Albania. *TransNEW project, FP7* The Scientific and Technological Research Council of Turkey (TUBITAK).

Tos, A. K., & Ozan, O. G. (2011). Deliverable D4.3 – Transport research capability in Malta. *TransNEW project, FP7* The Scientific and Technological Research Council of Turkey (TUBITAK).

Vincze-Pap, S. (2011). Deliverable D2.3 – Transport research capability in Hungary. *TransNEW project, FP7* JÁFI-AUTÓKUT Engineering Ltd., Hungary.

Wierszylo, J. (2011). Deliverable D2.2 – Transport research capability in Poland. *TransNEW project, FP7* Centrum Techniki Okretowej S.A. (Ship Design And Research Centre S.A.), Poland